

BEYOND ELECTROMAGNETIC WAVES

TransMaxwellian Physics

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THE-FOUNDATION-IS-THE-FRONTIER SERIES

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Essays on:
Physics in the Twenty-first Century
[Series Index](#)

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This essay is based on duly published scientific papers



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Imagine -----

Imagine the modern scientific and technological civilization without electromagnetic waves. What does it look like? In papers published in the mainstream physics journals, I proposed in 1992 that these waves may be just a limiting case of a vast world of electromagnetic phenomena that remains unexplored. This proposal seems to be bolstered by independent experimental developments, as well as by curious, little-investigated issues currently relegated to the footnotes of the Electromagnetic Theory. Imagine a future scientific and technological civilization based on this vastly expanded knowledge. What would it look like?

What is preventing us from exploring the possibility of this fantastic new world? It is the contemporary Physics Establishment.

GRAPHICS ACKNOWLEDGEMENTS:

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I

WHAT'S THE GO OF THAT?

When James Clerk Maxwell, in his boyhood, went out on walks with his father, he continuously asked "What's the go of that?", whenever he saw something he had not seen before. Nothing could be more appropriate subject for this question of his than what you will read below. James R. Newman, a modern biographer of Maxwell, concluded by saying: To this day the world has not fully comprehended the kingdom created by his imagination.



*James Clerk Maxwell - Did he find all there was to find?
The official view is that he did*

Maxwell died relatively young. His later life was difficult. He personally tended to his invalid wife before she passed away. At this time, he himself lived in a room so small that he had to sit on the bed and put his dinner plate on his lap while he worked. He kept hidden from others the news of his own illness, abdominal cancer, to which he would soon succumb. This is an endearing picture of a fine human being behind a great scientist. But it also makes one wonder if there were important matters left unfinished in the foundation of Electromagnetic (EM) Theory.

At the same time, it is also true that nothing of foundational nature has been added to Classical EM Theory in empty space after Maxwell. Therefore, if something was left unfinished, it is still to be discovered today.

Even within the world of Maxwellian phenomena in EM Theory, there are tantalizing clues to a world beyond. Some of these clues, as we shall see below, are contained in a mystery about antennas; in an overlooked solution of Maxwell's Equations; and in what is known as Low Frequency Magnetic Communication.

I present all this historical background to give some kind of a context, and not as a substitute for solid scientific justification - which is what my ideas are founded on.

II

MAXWELLIAN PHYSICS

We will first define Maxwellian Physics for our purpose, so that it will become clear what TransMaxwellian Physics is. As is well known today, Maxwell's ideas of EM Theory have been summed up in four equations involving the electric field E (or equivalently $D = \epsilon_0 E$, ϵ_0 being a constant), the magnetic field H (or equivalently $B = \mu_0 H$, μ_0 being a constant; we will use both H and B), the electric conduction current J :

$$\text{div} \mathbf{D} = \rho$$

$$\text{div} \mathbf{B} = 0$$

$$\text{curl} \mathbf{E} = - \frac{\partial \mathbf{B}}{\partial t}$$

$$\text{curl} \mathbf{H} = \mathbf{J} + \frac{\partial \mathbf{D}}{\partial t}$$

Here, ρ is the electric space charge density. Two of these equations contain the time t , and thus apply to time-varying fields. The other two apply to static fields.

Let us now, for the purpose of our discussion, consider only empty space with no sources ($\rho = 0, J = 0$).

TIME-VARYING CASE:

The two time-varying equations can be solved together to provide us the EM wave. In the EM wave, the electric and the magnetic fields bear a very specific and rigorous relationship, which corresponds to the electric and the magnetic energies being equal (i.e. in equipartition):

$$E = c B,$$

where c is the velocity of light. It is rigorous in the sense that you cannot make the above equality approximate: You cannot have any fuzziness in this. There can be no circumstance in empty space where this equality should not hold exactly.

The flow of energy in an EM field can be described by the Poynting Vector:

$$\mathbf{S} = \mathbf{E} \times \mathbf{H}$$

STATIC CASE:

If there is no time variation, then $E = 0$ and $B = 0$ (by Maxwell's Equations). Under these circumstances, the present theory holds, there is no physical solution in empty space for the static electric field E and the static magnetic field H . In other words, there cannot be floating around in empty space invisible isolated structures made entirely of electric field or magnetic field.

So far, everything that has been said is Maxwellian Physics.

III

THE POYNTING VECTOR

For our further discussion, it is helpful to reiterate the concept of the Poynting Vector in today's formulation as follows:

- A. The Poynting Vector follows from energy conservation. It has no other physical justification. It does not explain how the process of crossing the electric field with the magnetic field results in energy flow.
- B. In order for the Poynting Vector give the power flow, the electric field and the $\mathbf{E}$ and the magnetic field $\mathbf{H}$ must be connected to one another by Maxwell's equations.
- C. These fields must come from the same source.
- D. Therefore, electric and magnetic fields from different sources cannot be crossed to generate a meaningful Poynting vector. There exists no justification for this.
- E. While the Poynting Vector gives the power flow at a specific point in space, it does not say anything about the overall power flow pattern which must be calculated from the geometry of the field distribution or some other way. The power may, for example, be sloshing around in a local volume. Or it may be flowing out to infinite distances.

A corollary to the above is that the Poynting Vector is of no interest unless the fields are time-varying.

To emphasize the points that have just been made, we will rewrite the conventional Poynting Vector as follows:

$$\mathbf{S} = \mathbf{E}_1 \times \mathbf{H}_1$$

The subscript 1 referring to the single source of the E and the H fields.

Let us elaborate the points A-E above through an example. Suppose that two beams of EM wave 1 and 2 cross perpendicularly in free space. Their respective Poynting Vectors are:

$$\mathbf{S}_1 = \mathbf{E}_1 \times \mathbf{H}_1$$

$$\mathbf{S}_2 = \mathbf{E}_2 \times \mathbf{H}_2$$

so that you could write the net power flow at this point in space as

$$\mathbf{S}_a = \mathbf{S}_1 + \mathbf{S}_2.$$

But, you could also look at it in a different way. The net electric and the magnetic fields where the two beams meet are $\mathbf{E} = \mathbf{E}_1 + \mathbf{E}_2$ and $\mathbf{H} = \mathbf{H}_1 + \mathbf{H}_2$. The fields $\mathbf{E}$ and $\mathbf{H}$ are related to one another by Maxwell's Equations. Therefore, it is perfectly legitimate to write the net Poynting Vector as

$$\mathbf{S}_b = \mathbf{E} \times \mathbf{H} = (\mathbf{E}_1 \times \mathbf{H}_1) + (\mathbf{E}_2 \times \mathbf{H}_1) + (\mathbf{E}_1 \times \mathbf{H}_2) + (\mathbf{E}_2 \times \mathbf{H}_2)$$

Or

$$\mathbf{S}_b = \mathbf{S}_1 + \mathbf{S}_2 + (\mathbf{E}_2 \times \mathbf{H}_1) + (\mathbf{E}_1 \times \mathbf{H}_2)$$

So we have a problem: We have two different values $\mathbf{S}_a$ and $\mathbf{S}_b$ for the same power flow – both correct according to the definition! How do we reconcile this? In keeping with the terminology used by Maurice C. Hatley that we will discuss later, let us call the last two terms above the crossed-field terms.

The way out of this conundrum in the conventional theory is this: If you integrate $\mathbf{S}_b$ over a surface enclosing the entire region of overlap of the two waves, the crossed-field terms will integrate out to zero, leaving:

$$I(\mathbf{S}_a) = I(\mathbf{S}_b)$$

where I use $I(x)$ to indicate the surface integration. Thus, the crossed-field terms do nothing, and the two waves proceed on their way as though nothing happened in the region of the overlap. (The actual proof of this statement, which has to be done through detailed numerical computation, is not easy.)

At any rate, what emerges here is that *any crossed-field terms are spurious artifacts without any physical significance.*

IV

GOING BEYOND THE CONVENTIONAL POYNTING VECTOR

We will now depart from the above conventional interpretation as follows:

- (1). If you contrive to place, in the region of the meeting of the two waves, some device that will drain energy *from the crossed-field terms*, then the waves will proceed with diminished energy. We have put the crossed-field terms to real-life use! This is what my first 1992 paper (Paper A) showed.
- (2). If you contrive to pump energy into the crossed-field terms, then they can produce a net unidirectional energy flow out of the region of overlap – i.e. a new wave! This is what I showed in my second 1992 paper.
- (3). Maurice C. Hatley, through the invention of the crossed-field antenna starting about 1986, had already proved (2) to be correct (Unbeknownst to me then). He claims to have generated EM waves from the crossed-field terms.

So far, even though we have introduced a new significance to the crossed-field terms, we are still within the conventional EM Theory.

However, I have shown that even when source 1 is a wave and source 2 is a static magnetic field, there is a real and observable crossed-field term. Since the wave and the static field are not related by Maxwell's Equations, this case is definitely outside the conventional theory. We have stepped completely out of the "Poynting realm".

Second, I go on to suggest in my papers that the wave that is generated in (2) above is not an EM wave only, but a new wave called the companion wave. This wave does not follow from Maxwell's Equations. This is new physics by any definition: TransMaxwellian physics. We have stepped out of physics as it is known today.

V

TRANSMAXWELLIAN PHYSICS

By TransMaxwellian Physics is meant here that physics which does not emerge from the current formulation or interpretation of Maxwell's Equations. This includes physics that actually goes beyond Maxwell's Equations, or violates them. I like to say that this a greater world of which the world of Maxwell's Equations is a part. Therefore I do not say that my work violates Maxwell's Equations or modifies them.

TIME-VARYING CASE:

Contrary to the presently held view, I show that EM energy can propagate where the specific relationship between the electric and magnetic field does not hold:

$$E < c B.$$

A stepping stone to the above result is that, contrary to the current view, real and observable power flow can be represented by a crossed-field term.

STATIC CASE:

Contrary to the presently held view, I claim to have shown that there is a physically realistic static solution of Maxwell's Equations for the static magnetic field H: The source-free magnetic field structure (SFMS). It is a structure made of static magnetic field with no sources in it. It is a finite structure, with the field going to zero at infinite distance in all directions.

While the SFMS is suggested to be the solution of Maxwell's Equations, its further behavior violates the equations. For example, a SFMS moving with a velocity v constitutes a mode of free space propagation that is not consistent with the Equations (which predict only the EM wave traveling at the velocity c .) Thus we may imagine that a hint of the TransMaxwellian world is already contained in the Maxwellian world.

We are speaking here of an entire sea of EM phenomena heretofore unheard of. Of this sea, the EM wave is just the surface. Such a sea would be considered absurd within today's surface-dwelling physics. However, I will take you step by step into the depths of this sea.

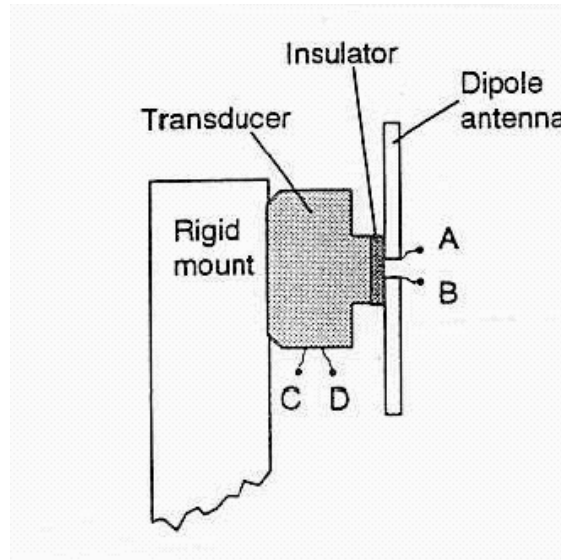
Detailed aspects of the static context of TransMaxwellian Physics have been taken up separately ([click](#)). Here we discuss the time-varying or the dynamic case.

VI

VACUUM ELECTROMAGNETIC INTERACTION

I demonstrated that a crossed-field Poynting Vector can represent real and observable power flow by means of a thought experiment (doable in real life) whose outcome is self-evident. For a detailed reference to this paper, Paper A, click [here](#). To view the entire paper online, click (.pdf, 1.2 MB) [here](#).

My demonstration is based on a conceptual device called the force-measuring antenna (FMA). Here a dipole antenna is mounted on a vibration transducer, which in turn is rigidly mounted to a mast fixed to the ground. The vibration transducer senses any mechanical vibrations of the antenna and generated a corresponding electrical output.



THE FORCE-MEASURING ANTENNA: Simple in concept, profound in significance

An electric dipole antenna is mounted on a mechanical vibration transducer, which in turn is mounted on a rigid mast. (Rigid means fixed immovably to the ground). If the antenna vibrates mechanically with respect to the ground, then a corresponding voltage signal appears between the terminals CD of the transducer. The EM signal appears conventionally between the terminals AB. So, seen as an integral antenna, it is a dual electrical output antenna: One output detects the EM wave crossing the antenna; the other output detects the EM momentum crossing the antenna.

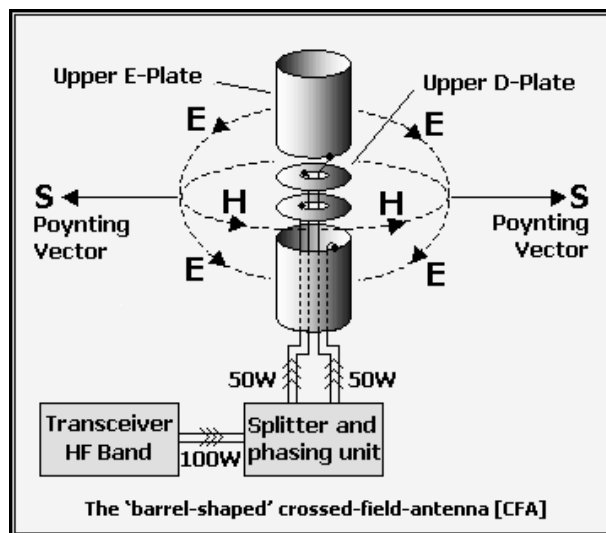
The idea of the FMA is simple. When an EM wave is incident on the dipole antenna, the electric field E_1 generates a current I on the arms of the dipole. It is well known that a conduction current I perpendicular to a magnetic field H feels a force $I \times B$. So there arises a force $I \times B_1$ on the dipole, which causes the antenna to mechanically vibrate. This vibration will be recorded in the transducer output. If there is an additional magnetic field H_2 (time-varying or static) parallel to H_1 , and from a different source, then there will be an additional force $I \times B_2$ which will also produce a vibration. The vibrations indicate flow a time-varying EM momentum moving past the antenna. Flow of momentum is flow of energy. Therefore, $E_1 \times H_2$ is also a meaningful "Poynting Vector". Since E_1 and H_2 are from different source, and since they meet in empty space devoid of all matter ("vacuum") to produce a real and observable phenomenon ("interaction"), I termed this phenomenon Vacuum Electromagnetic Interaction.

VII

EXPERIMENTAL EVIDENCE: THE CROSSED-FIELD ANTENNA

I had not known about the Crossed-Field Antenna (CFA) when I wrote my 1992 papers. Recently, Swedish electrical engineer Robert Bielik read about my ideas, and immediately saw that there might be a connection between these and

the CFA. He then brought the CFA to my attention. Subsequently, another Swedish electrical engineer, Håkan Widenstedt, did much to educate me on this subject. Finally, one of the inventors of this antenna, Maurice C. Hatelly, a professor of electrical engineering from England, helped me understand his discovery further.



*Maurice C. Hatelly and his original concept of the Crossed-field Antenna
Is Hatelly an inventor or a discoverer?
(Figures courtesy Håkan Widenstedt)*

The inventors of the CFA say that it is predicted in Maxwell's Equations (or a "corrected" version of these equations). They try to explain their invention with an interpretation of the conventional EM Theory. This suggestion is currently a subject of an acrimonious debate. For my purpose here, I will avoid this debate altogether. I need only take that aspect of the CFA which is not in question (or has not been experimentally disproved): The CFA works!



The 100kW CFA in Tanta Egypt
The man to the left is Mr. Robert F. Richter. The man to the right is Mr. Mahmoud Khattab, the Head of Projects at the Egyptian Radio and Television Union (ERTU) during their CFA developing program in the 1990's

A later version of the Crossed-Field Antenna (CFA)(courtesy Håkan Widenstedt)

In its simplest form, the CFA consists of two capacitors, each made of two coaxial cylinders (or two discs). All four cylinders/discs are placed coaxially. The two middle cylinders constitute one capacitor (called the D plates), and the two end cylinders constitute a second capacitor (called the E plates).

Now, the central idea of the CFA is this: Take the electric field E_e generated by the E plates, and the magnetic field H_d generated by the D plates. They are perpendicular to each other, so that their cross product, according to the inventors, is a synthetic Poynting Vector (Hence the name of their theory: Poynting Vector Synthesis). Under some conditions (to be discussed later), they observe that an EM wave is efficiently radiated from this electrically small antenna, corresponding to their synthetic Poynting Vector. The smallness of the antenna and the broadness of the bandwidth defy current wisdom.

As I said before, there is no basis in conventional EM Theory for a synthetic Poynting Vector that corresponds to a real power flow. Unbeknownst to me, the inventors had already experimentally verified my theory of Vacuum EM Interaction. I could not have done it better myself.

VIII

THE ELECTROMAGNETIC COMPANION WAVE

I suggested that the EM wave with $E = cB$ may not be the only way in which EM energy propagates in free space. I suggested that this energy may propagate with an arbitrary ratio

$$E/B < c.$$

This type of propagation I called the companion wave. I will now explain this nomenclature.

To generate the synthetic Poynting Vector, I used for source 1 an electric dipole (frequency f_1), and for source 2 a magnetic loop (frequency f_2). They are placed close together. The magnetic field H_2 of the loop is parallel to the magnetic field H_1 from the dipole. The dipole is radiation an EM wave corresponding to the Poynting Vector

$$S_{\text{conv}} = \mathbf{E}_1 \times \mathbf{H}_1$$

There is a second Poynting Vector

$$S_{\text{comp}} = \mathbf{E}_1 \times \mathbf{H}_2,$$

and a corresponding power flow. Next I suggest that the positioning of the source could be arranged so that the integrated power flow from $\mathbf{S}$ is a net outward flow. Thus, in addition to the EM wave, we have a power flow that is not EM wave. It is a companion to the EM wave: A companion wave. Read about this in my second paper on the subject (Paper B: [Detailed reference](#); [Online copy \(pdf, 170 KB\)](#)).

The companion wave in my view is essentially an expansion of the magnetic energy of the loop out to infinity.

Now, can we arrange the geometry of the sources so that there will be net outward flow of the companion wave power?

You need not start thinking about horrendous integration. The answer is yes. Maurice Hately has shown us more than one configurations where this is the case.

Therefore, the idea of companion wave is on very solid ground.

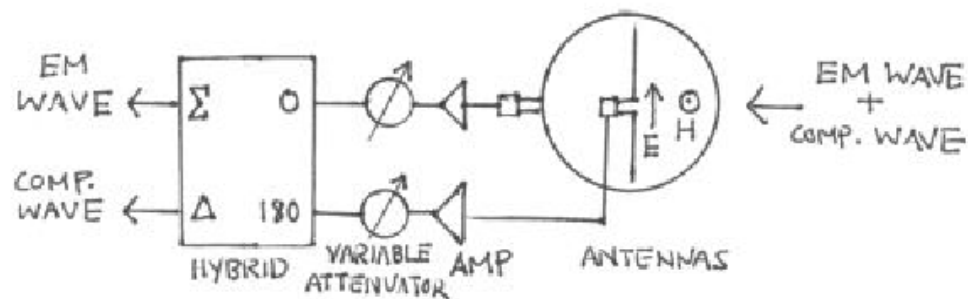
The obvious question now is: Is the CFA generating only the EM wave, or both the EM wave and the companion wave?

IX

RECEPTION OF THE COMPANION WAVE: THE CONCEPTUAL NULL ANTENNA

With a new mode of EM energy propagation comes an entire technology parallel to that for the EM wave. The first of these concerns how to receive a companion wave as distinct from the EM wave.

For this purpose I propose the conceptual null antenna.



The Null Antenna: Simple in construction, profound in scope

Take a dipole antenna which senses the E field, and a loop antenna which senses the B field. Superimpose them (not touching) so they look like a circle with a vertical diameter. Normalize their voltage outputs in presence of a known EM wave (by adjustable gain amplifier or variable attenuator) so the voltages are equal. Adjust their phases to be the same (by using phase shifters or adjusting cable length), before combining them in a 180-degree hybrid. When both EM wave and companion wave are incident on this calibrated antenna system, the Delta-channel output of the hybrid is the pure companion wave signal. The Sum-channel output is the conventional EM wave signal.

To the extent I am aware, the question of EM energy propagation with $E < cB$ never came up in the past, and has never been experimentally investigated. I am also not aware if even the quantitative exactitude of the relation $E = cB$ has ever been rigorously verified by experiments on propagating EM energy (of unknown origin especially). So, there exist no previous experimental data to preclude the companion wave out of hand.

X

SUPPORT FOR THE COMPANION WAVE: LOW FREQUENCY MAGNETIC COMMUNICATION

There are two conceptual barriers one might face in accepting the idea of the companion wave. First, a scientific barrier: The idea exceeds Maxwell's Equations. Second, a "gut feeling" barrier: How can energy propagate with $E < cB$ when we have known all along that $E = cB$ is the only game in town!

The second one can be readily dispelled even with today's state of knowledge. Energy does in fact propagate with $E < c B$. To see this, we have to consider a minor footnote of the EM Theory – Low Frequency Magnetic Communication.

Here, a magnetic field is set up by means of an electromagnet whose current can be modulated, at Transmit Station A. The Receive Station B is located within such a distance that the direct field of this magnetic can be detected. By modulating the current at A, a signal can thus be sent to B. At B, the signal is mostly magnetic field, so that $E < c B$. This much is well known, and this technology is in commercial use.

But from here, things get murky. Those who use this technology say that there is no "propagation". Since B is seeing the direct magnetic field, he receives the signal instantly. However, there does not appear to be any experimental data to support this or to disprove this. Others try to force-fit this situation into EM Antenna Theory by calling this near field communication, i.e. the magnetic field lines always remain connected to the antenna. Basically, all we have today as explanation of Low Frequency Magnetic Communication are various labels.

Now, theoretically, there is nothing that says the distance AB cannot be arbitrarily long (higher transmit power, lower receive threshold). Suppose that AB is 1 mile. Can we communicate instantly across this distance? Of course not. There will be involved some finite time lapse, which would correspond to a propagation velocity. But this velocity is not necessarily c . What it is we do not know. It is therefore incorrect to say that low frequency magnetic communication is instantaneous. It is correct to say that it is not *EM wave*.

Now here is the crux of our issue: Why do I say *propagation*? Based on what theorem or which equations? Actually, none. I am using here a very powerful tool the Good Lord in his infinite wisdom has given us mortals, Common Sense. If I generate energy at A, and if it is to appear at B, how can it get there except by propagating, or simply put, by traveling? But in science, you have to keep an open mind as to alternative possibilities. There is none. Unless you go with a Princeton professor who has a few tricks. He can learn you a thing or two. Apparently, he knows of some half dozen spatial dimensions beyond just the common garden variety x and y and z . So if he were to send the energy through some of them hidden dimensions, who is to know how it will go? But this professor is said to think like the Good Lord Himself. We are only using here the capacity of our all-too-human minds. So this is my disclaimer.

Low Frequency Magnetic Communication therefore shows that a signal can *propagate* through free space from one place to another with $E < c B$.

Suppose that the observer at B has no knowledge about the source. If he is receiving the signal with a conventional electric or magnetic field-sensing antenna, he will think he is receiving an EM wave. If he is testing the received radiation for companion wave, he will think he is receiving a companion wave. This shows you clearly that if you do not know anything about the source, there are three possibilities about what you are receiving:

- (a) EM wave
- (b) Low Frequency Magnetic Communication
- (c) Companion wave

So, for example, when in astronomical observations one receives an unknown radiation from an unknown source, what should one assume?

Low Frequency Magnetic Communication is one of the most significant scientific issues at the core of EM Theory. Yet most standard textbooks steer clear of this. This is because any mention of this runs the risk of your distinguished physics professor being put in the uncomfortable position of having to reconcile – in front of the entire class - free space propagation at $E < cB$ with Maxwell's Equations. It is much better to shove such things under the proverbial rug. What is after all more important: your gaining true knowledge or your professor saving his illustrious face?

XI

THE CFA AND THE COMPANION WAVE

The CFA Poynting Vector is at first:

$$\mathbf{S}_{\text{CFA}} = \mathbf{E}_e \times \mathbf{H}_d,$$

the subscripts e and d referring to the E and D plates, respectively.

Now, however, Hately imposes a number of conditions on $\mathbf{E}_e$ and $\mathbf{H}_d$. Basically, he wants to make them as though they were the electric and the magnetic fields in a freely propagating EM wave. So he makes $\mathbf{E}_e = c\mathbf{B}_d$. Then he tries to make a roughly spherical wavefront by adjusting the capacitor geometry. Only then does he get his antenna to radiate. I give you Hately's specific conditions in his own words, as written to me:

The radio waves are generated in a volume of space which has:

1. *E field Lines crossing H lines at right angles,*
2. *Ditto in phase at all times,*
3. *Lines having half the transmitter power in each type,*
4. *Lines proportioned so the $E/H = 376$ ohms*
5. *Correct spin to direct energy outwards*
6. *Both sets of lines have the same CURVATURE in the volume (i.e. so that they constitute a portion of a spherical wave-front and can therefore expand out into space*

The action can only occur with very careful precision afforded to 6 criteria simultaneously. That is why it has never been found accidentally by anyone. We only found it to work because we were careful to include all the criteria simultaneously.

There are two interesting points to note here:

First, although we are in the antenna zone, Hately arranges his fields act as though they were *free space* EM wave fields. So he departs from the conventional Antenna Theory.

Second, by arranging the fields in this way, he achieves the equipartition of energy characteristic of free space EM waves, but misses out on the most important characteristic of such waves: In spite of all his efforts, his fields $\mathbf{E}_e$ and $\mathbf{H}_d$ are not related to each other by Maxwell's Equations ($\mathbf{E}_e$ is related to $\mathbf{H}_e$, and $\mathbf{E}_d$ is related to $\mathbf{H}_d$ by these equations). So he departs from conventional EM theory

By Hately's own account then, in order for the CFA to work, one must take leave of conventional ideas. So why keep this discussion within the conventional theory and debate it there? Is this the correct venue? Or is it playing the wrong game in the wrong ballpark?

I will not answer these questions, but I will put my own interpretation on the CFA. First, we note that it is only an assumption that the CFA radiates pure EM wave. Normally, this would be "a given". There simply is no other possibility to consider. So this question would never have arisen in a thousand years. However, because of my companion wave theory, I can raise this question. I can suggest that the radiation from the CFA be examined with a Null Antenna while various things at the CFA are tweaked.

Second, in the conventional antenna theory, when things are tweaked at the antenna, its gain, radiation pattern etc change. However, if we change the power level, nothing happens. In the CFA, however, we have the unique and the new possibility of tweaking the *relative* powers (the ratio E_1/cH_2). What will happen to the radiation when this is done?

Third, what will happen if the two capacitors are driven at different frequencies?

It seems to me that the CFA radiation is the most logical and convenient place today to hunt for the companion wave.

XII

WHAT IS THE VELOCITY OF THE COMPANION WAVE?

What is the velocity v of energy propagation in the companion wave? In my originals papers I suggested that $v = c$, the velocity of light. But it is not clear to me anymore that that is the case. Three points may be noted in this connection:

- (1) The velocity of EM wave communication is c .
- (2) There experimental suggestion that [in the near field of an antenna, the velocity is greater than \$c\$](#) .
- (3) On the other hand, if magnetic field is a mass ([as has been proposed elsewhere](#)), that suggests that an expansion of magnetic energy in space and time might occur with $v < c$.

The issue of the velocity of the companion wave therefore remains open. Is the companion wave, like EM wave, limited to a maximum velocity c ? Or is the companion wave, in addition to being [transMaxwellian](#), also [transEinsteinian](#)?

The question of velocity should be explored experimentally once the companion wave has been detected. The theory for this velocity should come afterward.

XIII

THE EH ANTENNA PUZZLE

Recently, the [EH Antenna](#) was brought to my attention by its inventor Ted Hart and others. It is apparently another convention-defying, electrically small antenna that is said to work fine, but is being dismissed as crank by the mainstream cognoscenti.



Inventor Ted Hart (left), and a version of the EH Antenna, showing the capacitor cylinders and the inductance coils.

It seems to me from the description of the antenna, and not having seen the actual device, that the EH antenna may be working on the same principle as the CFA. As with the CFA, the magnetic field H_d here is derived from a capacitor. But unlike the CFA, the electric field E_e is said to form between the upper capacitor plate and the magnetic coil.

Now, for years, those who have been studying the EH Antenna around the world have been independently reporting strange behavior. At the same time, the theory of the companion wave can be used to predict certain behaviors that distinguish a companion wave from an EM wave. It is worthwhile at this stage to compare these predictions with the

observed “strange” behavior of the EH Antenna. The information presented below was presented to me anecdotally, but is otherwise not documented.

PREDICTION 1:

Since the E field in the companion wave is small compared to that in a corresponding EM wave (of same total power flow), the former can pass clear through a metal foil while the latter will essentially be stopped.

This strange behavior has reportedly been observed.

PREDICTION 2:

For the same reason, the companion wave can travel large distances in seawater while a corresponding EM wave will be rapidly attenuated.

This strange behavior has reportedly been observed.

PREDICTION 3:

If an antenna is radiating efficiently in the companion wave mode, its input will show a low VSWR. However, if the radiation from the antenna is observed at a distance with a conventional electric field-sensing antenna (e.g. a dipole), then the antenna will appear to be a poor radiator. Thus, one is faced with a mystery: Low input VSWR and a poor radiator.

This strange behavior has reportedly been observed.

PREDICTION 4:

Since electric field is insignificant in the companion wave, any attempt to characterize the "conventional" antenna radiation pattern by an electric-field sensing antenna may encounter strange problems.

This strange behavior has reportedly been observed.

PREDICTION 5:

According to the original derivation of the companion wave, EM wave and companion wave are produced as a combination. Therefore, it is possible for such an antenna to function as a conventional antenna in some circumstances, and not in others.

This strange behavior has reportedly been observed.

For the EH Antenna to generate the companion wave, it is of course necessary that the antenna provide, somewhat unusually, substantial magnetic energy. But that is precisely the case with the EH Antenna - because of the large inductance coil used as an integral part of the antenna. So, things seem to fit together.

It would therefore be interesting to examine the radiation from the EH Antenna for the presence of the companion wave.

XIV

THE MYSTERY ABOUT ANTENNAS

We started our discussion with some of the most theoretical issues of EM Theory, but before long, we were talking extensively of antennas, bits and pieces of metal! This may sound strange, but this may actually be indicative of where our answer lies: In the mysterious interface between EM Theory and Antenna Engineering.

If a static magnetic field is produced in a current loop, every magnetic field line – no matter how far from the loop – will pass through this loop. However, if this loop were a radiating antenna, the magnetic field lines far from the loop do not pass through the loop. They close upon themselves in empty space. So there is a transition, somewhere near the loop, between the field lines that pass through the loop and that do not. The same thing can be said about the electric field lines in a dipole antenna. Up to a distance, these lines terminate on the arms of the dipole. Beyond this, they close in empty space.

Everything about the above antennas is understandable (and calculable) on the basis of Maxwell's Equations, except this transition. This is the most illustrative symptom of the grand mystery about antennas. It is a mystery that exists in the interface between EM Theory and Antenna Engineering.

I hasten to add here that there are many who will tell you that this is all nonsense, that they have got it all sewn up and there is no mystery about antennas. If you ask them to explain the transition, they will say it is not important.

If you have a theory that explains in great exactitude everything except for a tiny hitch, do you brush this hitch under the rug or do you conclude that this is a telling sign of something missing in the theory? In the case of the antenna, is the inexplicable transition something you should ignore on no scientific grounds whatsoever, but just on the grounds that higher minds have told you to ignore this? Or do you say that this is symptomatic of something missing in Maxwell's Equations? And if something were missing in Maxwell's Equations, what would you call it? May be TransMaxwellian physics?

I do not know at this time what this transition may have to do with the companion wave. All I am saying for the time being that the mystery about the antennas points us to TransMaxwellian physics that we have arrived at from completely independent considerations.

XV

REMARKS: THE RIDDLE OF THE EMPTY DIAGRAM

What I have proposed here is an enormous expansion of the foundation of the Electromagnetic Theory. But this particular site covers only a portion of the new physics that I have proposed. To see my ideas in their entirety, please go to my [Homepage](#), and start from there.

As far as this site is concerned, I have divided my ideas into two parts.

First, the suggestion that the crossed-field energy flow terms are real. This suggestion seems to have been confirmed by the CFA Antenna.

Second, I have proposed a vast realm of companion waves – of which the EM waves are only a limiting case. Far from being outlandish or absurd, this idea is in fact embodied in something we know and employ today: Low Frequency Magnetic Communication.

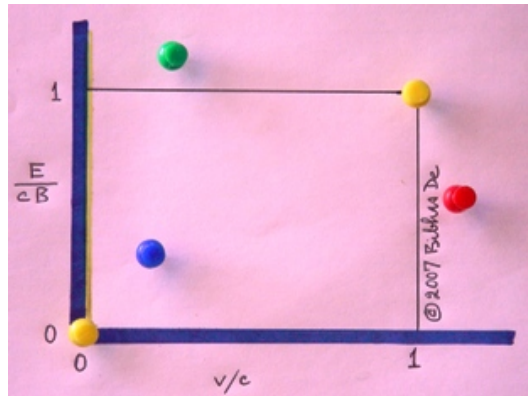
And even though I have proposed entirely new physics, I have couched it in the form of an easily testable experimental proposition. I have conceived of a conceptually simple device, the Null Antenna, with which to search for companion waves. These waves may be present in [astronomical signals](#), and possibly in the radiation emitted by the Crossed-field Antenna and the EH Antenna.

As you think further, bear one thing in mind: The constancy and the inviolability of the velocity of light c are established from various directions. First, the constancy of c emerges from plane EM wave solution of Maxwell's Equations. The quantity c is a function of fundamental physical constants, and therefore it is itself a constant. The value of c has been experimentally verified for freely propagating waves. "Freely propagating" means that you set up the receiving station far away from the source of the wave. The inviolability of c (that EM communication cannot occur at

velocities greater than c) emerges from Einstein's relativity. From all these, it is concluded that EM communication in free space occurs always at the velocity c .

But, as we have discussed, there are a host of situations of EM communication that are outside the above arena. So, there is no cause to get hung up on c being the be-all and end-all of EM communication.

In closing, I leave you to ponder The Riddle of the Empty Diagram:



Universal Diagram of Free Space EM Phenomena

In this dimensionless diagram, the yellow pushpins represent static magnetic field (0,0) and electromagnetic wave (1,1); the yellow-shaded ordinate indicates time-varying but non-propagating EM fields. The question is: Is the rest of this diagram empty, as the current lore holds?

Where does, for example, Low Frequency Magnetic Communication fit in? It is the blue pushpin. Where does superluminal near field of an antenna fall? The red pushpin. Where does Lewey Gilstrap's electrostatic communication (see Appendix) fall? It is the green pushpin. But all the three pushpins have been placed arbitrarily. So you can move them around. Thus you can create red, blue and green clouds in the empty space of the diagram.

Now continue this process of thinking!

Where does companion wave fit in?

Do you have any problems with this concept anymore?

When all is said and done to substantiate an idea, physics-wise, people today invoke a sublime consideration for good measure. In today's world of theoretical physics, much is made of something called "beauty" – or more specifically, "mathematical beauty". If a new theory has mathematical beauty, then that is a point in the theory's favor. With reference to a set of controversial new ideas, which are said to have great mathematical beauty, one prominent physicist says: "How can so much beauty go to waste?!" So there must be something to these ideas! Now, I must admit that I am unable to appreciate mathematical beauty, which seems to me purely subjective. But if such sublime criteria can be invoked in physics, let me suggest "satisfaction". Satisfaction here is rooted in scientific intuition which is born of the scientific experience. Here is no issue of beauty. Here is simply the issue of whether things fall in place for you. Is a new theory satisfying to you? Look at the above diagram. Is this not a satisfying diagram, its entire field pregnant with meaning? And what is more satisfying: That there should be just two distinct yellow points, or that there should be a multicolor mist inhabiting the diagram?

Here is the significance of the diagram: As soon as you have convinced yourself to put just one more point anywhere in this diagram - red, blue or green, you have exceeded the boundary of Maxwellian Physics.

Moreover, as I said, if you can place just one such point, it means you can place many such points - in fact a mist filling the entire diagram. Thus, you have entered the world of:

TransMaxwellian Physics

Welcome to my world!

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Posted: 10/7/02; Last modified: 04/18/07



APPENDIX The Idea of Lewey Gilstrap

[On March 2, 2007, I got an email from Lewey Gilstrap. Portions of that email are reproduced below with his permission. I found his idea interesting.]

What this amounts to, in essence, is that electromagnetic energy can propagate over a continuum of conditions from $E < cB$ through $E = cB$ to $E > cB$. The first part of this spectrum is what I have described. The second part is what Gilstrap describes. That is to say, the conventional electromagnetic wave (with $E = cB$) – which today is seen as the be all and end all of electromagnetic propagation – is just one point in this spectrum.

The enormity of the combined idea can be seen by considering just one minor consequence of it: It will put paid to the anointed cosmological discoveries that are based on the assumption that electromagnetic waves are the only form of electromagnetic energy propagating in the universe. – BRD]



Lewey Gilstrap

A non-physicist with remarkable physics insight?

A few days ago, I ran across your website while doing a search for related items. I had not been aware of your work before, and I read with considerable interest the material on the Companion Wave. However, I was disappointed that you did not mention the electric wave twin of the magnetic Companion wave. The twin is just as interesting as the Companion. Both the Companion wave and its twin are longitudinal, both propagate through salt water without loss other than normal inverse square loss and neither is stopped by a Faraday cage; for the Companion wave, $E < cB$ and for the twin, $cB < E$. Both the Companion and its twin can be detected as end fire (not transverse) from an ordinary

dipole, but it takes special phasing or a special antenna to detect either one. I showed that both waves satisfy Maxwell's equations and that no modification of Maxwell's equations is needed.

The reason I know about these waves is that I got a patent on the electrostatic wave (actually, on the antenna, which was quite different from a normal dipole and it did not involve crossed fields). The patent was awarded in 1976 (Electrostatic Communications System; United States Patent 3964051). I knew about the Companion wave, but my antenna design for the magnetic wave would have required a lab for fabrication which was not available to me and I just dropped further work on it. Later, I got a contract to build two prototypes of the electric wave system for the Navy. The units were tested first in a swimming pool and later in the Chesapeake Bay. The units had a carrier frequency of 10 MHz, and, although the range of the units was not very great, we did show that there was no exponential attenuation of the signal (other than inverse square spreading) for around 10 wavelengths separation of the transmitter and receiver. Unfortunately, the naysayers in the Navy killed any further development, claiming that "it would not work." (Yes, they ignored my physical reasoning, my mathematical reasoning, and the experimental work with the prototypes.) My estimate as to potential range after several years of development was on the order of 1000 km, although that might have been optimistic. After seeing your material, I think that I could do a much better job of antenna design for either of the twins now than I did twenty years ago. I long since stopped working on the two waves, but have used some of the principles I developed for them for investigation of other non-standard waves, one of which is even more exotic than the twins.

Lewey Gilstrap

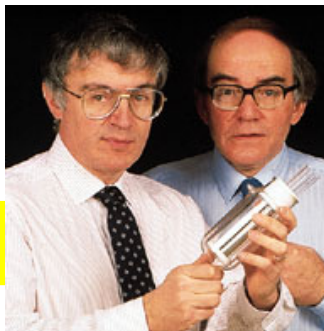


Suggested further reading: ***THE GREAT COSMIC SITAR***

(Yes, this is about physics!)

A SPECIAL EXHIBIT ON WHAT IS GOING ON WITH PHYSICS TODAY

FIVE WHO CAME TO PHYSICS...



Stanley Pons and Martin Fleischmann

WHAT THEY DID: Got carried away with a fantastic discovery that turned out to be wrong
WHAT WAS DONE TO THEM: Their lives were destroyed

WHO DID THIS: The physics establishment
WHAT THE WORLD MEDIA DID: Intensely ridiculed the two
WHAT THEIR EMPLOYERS DID: Abandoned them



Victor Ninov and Jan Hendrik Schoen

WHAT THEY DID: Cooked data
WHAT WAS DONE TO THEM: Their lives were destroyed
WHO DID THIS: The physics establishment
WHAT THE WORLD MEDIA DID: Tore the two up like a hungry wolf-pack
WHAT THEIR EMPLOYERS DID: Terminated them



John C. Mather

WHAT HE DID: Spinned a miserably failed satellite experiment as *the* most precision measurement in the history of physics
WHAT WAS DONE TO HIM: See above
WHO DID THIS: The physics establishment
WHAT THE WORLD MEDIA DID: Danced with him on their shoulder
WHAT HIS EMPLOYER DID: Appointed him America's top space scientist

Bob Dylan asks:

When you gonna wake up ...?

For further details please visit:

[THE PHYSICS NOBEL PRIZE FRAUD OF 2006](#)